NUMERICAL COMPUTATION, NC (4777) A2

Objectives

To extend the repertoire of techniques developed in *Numerical Methods* and, with the aid of suitable software, to give experience in using them.

To state or prove theoretical results about the accuracy of these numerical techniques and, with the aid of suitable software, to demonstrate the control of error in practice.

To implement these numerical methods on computers and to be aware of the difficulties which can arise in doing so.

Assessment

Examination (72 marks)
2◒ hours
Candidates answer three questions out of four.
Each question is worth 24 marks.

Candidates require access to a computer with a spreadsheet program, and suitable printing facilities, throughout the examination.

Assumed Knowledge

Candidates are expected to know the content of *C1*, *C2*, *C3* and *C4* and *NM*.

Calculators

In the MEI Structured Mathematics specification, no calculator is allowed in the examination for *C1*. For all other units, including this one, a graphical calculator is allowed.

NUMERICAL COMPUTATION, NC		
Specification	**Ref.**	**Competence Statements**
SOLUTION OF EQUATIONS		
Relaxation. Richardson's method. Aitken's delta squared method.	NCe1	Be able to use relaxation and the methods of Richardson and Aitken to accelerate convergence.
NUMERICAL INTEGRATION		
Romberg's method.	NCc1	Be able to perform Romberg integration on definite integrals.
Gaussian methods.	2	Understand the principles of Gaussian methods.
	3	Be able to apply Gaussian methods to the evaluation of integrals.
DIFFERENTIAL EQUATIONS		
The Euler Method. The modified Euler method (Runge-Kutta order 2).	NCc4	Know how to solve a given first order differential equation $\frac{\mathrm{d}y}{\mathrm{d}x} = \mathrm{f}(x, y)$ with initial conditions to any required degree of accuracy by repeated application of these methods.
	5	Understand that the modified Euler method converges more rapidly than the Euler method.
Predictor-corrector methods.	6	Be able to solve first order differential equations using predictor-corrector methods.
Runge-Kutta methods.	7	Understand the concepts underlying the Runge-Kutta methods.
	8	Be able to solve first order differential equations using Runge-Kutta methods.
	9	Understand that higher order Runge-Kutta methods converge more rapidly than lower order methods.
Finite difference methods.	10	Be able to use finite difference methods for solving second order differential equations.

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Specification	**Ref.**	**Competence Statements**
APPROXIMATION TO FUNCTIONS		
Least squares.	NCc11	Be able to approximate data by simple functions (e.g. quadratics and cubics) using the least squares method.
Newton's divided difference method.	12	Be able to interpolate polynomials and approximate values of functions from tabulated data, using Newton's divided difference formula.
LINEAR ALGEBRA		
Gaussian elimination. Pivoting. Matrix inversion. Determinants.	NCm1	Be able to solve systems of linear equations, invert matrices, find determinants using Gaussian elimination and pivoting strategies.
Gauss-Jacobi method. Gauss-Seidel method.	2	Be able to solve systems of linear equations using iterative methods. Understand and use the condition of diagonal dominance.